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67,010-089; H2751-ED

UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: James Gustafson

Serial No.: 10/804,305

Filed: 3/19/2004

Art Unit: 2834

Examiner: Lam, Thanh

Title: FLUID-SUBMERGED ELECTRIC MOTOR

Mail Stop AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

APPEAL BRIEF

Dear Sir:

Subsequent to the Notice of Appeal mailed to the Patent and Trademark Office on 16 February 2007, Appellant now submits its Brief. Fees in the amount of $500.00 were previously paid with the Appeal Brief filed on 22 November 2005. If any additional fees are necessary, you are hereby authorized to charge Deposit Account No. 08-0385 in the name of Hamilton Sundstrand Corporation.

Real Party in Interest

The real party in interest is Hamilton Sundstrand, assignee of the present invention.

Related Appeals and Interferences

The subject Application was appealed on 14 October 2005. Prior to a decision, the finality of the rejection was withdrawn in the Office Action mailed on 6 February 2006.

Status of the Claims

Claims 1, 4, 6, 10, 11, 13-18, and 24-30 stand rejected. Claims 20-23 were previously withdrawn. Claims 1, 4, 6, 10, 11, 13-18, and 20-30 are therefore pending in the application.

Status of Amendments

The amendments filed 11 January 2007 are unentered.

Summary of Claimed Subject Matter

The present invention is directed to electric starters, and more particularly to starters having electric motors. Large-scale power generators often use gas turbine engines to supply power to a geographic region. Reliable start up of these engines is critical to ensure that power outages do not occur. [see paragraph 2]

Electric starters are known for starting small engines, but the special requirements of large engines have generally made them inappropriate for use with large engines. Many gas turbines in the 20 to 50 MW range are derivatives of aircraft engines (known as "aeroderivatives") and, as such, they initially retained the lightweight, high-performance pneumatic starters from the initial design. As applications evolved, the pneumatic starters were replaced with hydraulic starters because weight is less of a concern in ground-based gas turbine engines. The next logical step is to apply electric motors to replace the hydraulic starter units. [see paragraph 3]

Figure 3 (reproduced below) shows an electric starter 100, having an electric motor 100a, such as a permanent magnet motor or switched reluctance motor, and a clutch 100b within a single package. In the embodiment shown in Figure 3, the electric motor 100a is enclosed in a

fluid-filled cavity 102 of a housing 103. The cavity 102 substantially encloses the motor 100a and has a fluid inlet 104 and a fluid outlet 106 to allow the fluid held in the cavity 102 to be circulated, removed and replaced when needed. The motor 100a itself can be any electric motor. As is known in the art, the motor 100a has a rotor 108, a stator iron 110, stator windings 112, and rotor bearings 114. [see paragraph 16]

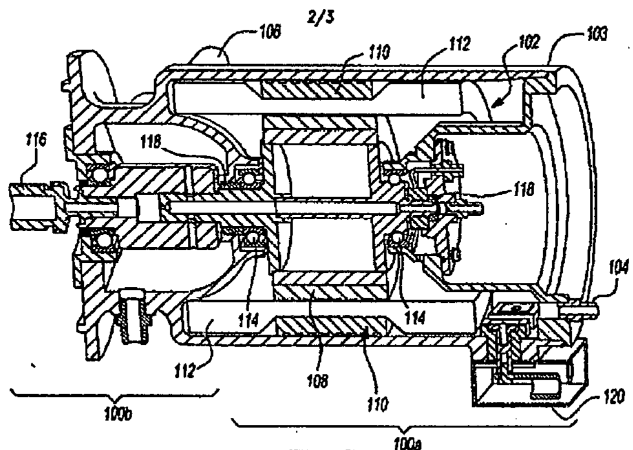

Fig-3

The cavity 102 can be filled with any fluid having heat conducting properties to ensure heat transfer from the motor components to the fluid. In one embodiment, the fluid is a dielectric oil, such as some commonly used synthetic gas turbine engine oils. Other fluids having similar characteristics may also be used. [see paragraph 17]

Submerging parts of the motor 100a in the fluid rather than relying on air cooling or spray cooling ensures that the fluid is in constant intimate contact with heat-generating motor components and flows over all of the surfaces of the components, greatly improving the heat transfer rate away from the components over previously-used cooling methods. [see paragraph 20]

The fluid may also have a high electrical resistance to electrically isolate the wires in the stator winding 112, preventing them from shorting to each other, to the housing, and to other motor components. A dielectric oil would have this characteristic. [see paragraph 22]

The fluid held in the cavity 102 may also act as a lubricant to lubricate the motor components, such as the rotor bearings 114. [see paragraph 23]

Using the same fluid for both thermal management and lubrication allows the inventive structure to solve many existing problems at once. By flooding the motor components in a cooling, lubricating fluid, such as a dielectric oil, the inventive structure can provide effective thermal management, isolate the motor from flammable gases, and provide continuous lubrication all at the same time. These features are especially effective in starter applications, where the cooling capacity is normally low if air cooling is employed. [see paragraph 24]

Figure 4 (reproduced below) illustrates an embodiment where the starter 100 is partitioned so that the rotor 108 is separated from the stator iron 110 and stator windings 112.

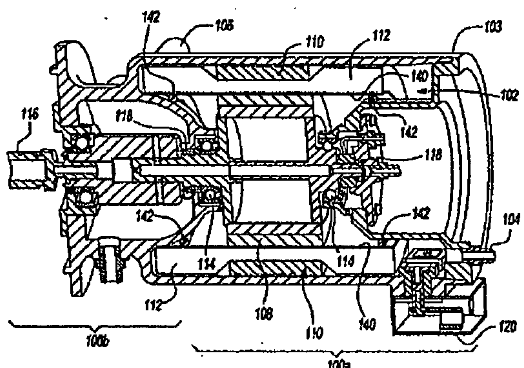

Fig-4

A can-shaped partition 140 connected to the fluid inlet 104 and the fluid outlet 106 encloses the rotor 108. The space between the outside of the partition 140 and the housing 103 forms the fluid-filled cavity 102, causing the fluid to surround only the stator components and not the rotor 108 in this embodiment. [see paragraph 25]

Summary of Claim 1

Claim 1 recites:

1. An electric motor assembly, comprising:

a fluid circulation circuit;

a housing having a cavity that is fluidly connected to said fluid circulation circuit;

an electric motor having at least one electric motor component disposed in the cavity; and

a thermally conductive dielectric fluid for circulation through the cavity to substantially submerge said at least one electric motor component.

Referring to paragraph 16, independent Claim 1 recites an electric motor assembly 148 that comprises a fluid circulation circuit (e.g., cavity 102, inlet 104, outlet 106, Figure 5), a housing 103 having a cavity 102 that is fluidly connected to said fluid circulation circuit, an electric motor 100 having at least one electric motor component (e.g., 108, 110, 112, 114) disposed in the cavity, and a thermally conductive fluid for circulation through the cavity 102 to substantially submerge said at least one electric motor component.

Grounds of Rejection to Review on Appeal

A. Whether claims 1, 4-6, 13, 14, and 20-22 were properly rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 1,531,724 to Arutunoff.

B. Whether claims 10-12, 16, and 24-30 were properly rejected under 35 U.S.C. §103(a) as being unpatentable over Arutunoff in view of U.S. Patent No. 5,034,638 to McCabria.

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Arguments

A. REJECTION OF CLAIMS 1, 4-6, 13, 14, and 20-22 UNDER §102(b)

The Examiner argues that Arutunoff discloses all the features of independent claim 1, including "a thermally conductive dielectric fluid." Arutunoff refers throughout to an internal liquid or oil, but does not disclose the use of dielectric fluid. Indeed, Arutunoff does not even mention the word "dielectric." Claim 1 recites something more than just oil or internal liquid. The oil or internal liquid must have the particular feature of being a dielectric fluid. As an example of the dielectric fluid, Specification paragraph 17 discloses synthetic gas turbine engine oils. Arutunoff fails to disclose a synthetic gas turbine engine oil and fails to disclose the use of any dielectric fluid or benefit therefrom.

The Examiner is relegated to arguing that the oil of Arutunoff is inherently dielectric because the stator winding would otherwise be short-circuited. In order to rely on inherency as the basis for the rejection, the Examiner must show more than a mere probability or possibility that the oil of Arutunoff is dielectric. That is, the Examiner must show that the oil in Arutunoff is inevitably or invariably always dielectric. In Arutunoff, the oil passes through the passages K between the stator field coils (see page 3, column 2, lines 74-82). As seen in Figures 2 and 3 of Arutunoff, the passages K extend between the coils 18 do not appear to directly contact the coils. Therefore, the Examiner's argument that the oil must be dielectric because the coils would otherwise be short-circuited has no basis because the oil does not even directly contact the coils to provide the possibility of short-circuiting.

The Examiner also argues that the oil of Arutunoff is "pure" and therefore inherently dielectric. The purity of the oil in Arutunoff refers to the filter 24 that is used to separate heavy particles from the oil. The filter would not separate other types of impurities, such as water moisture, from the oil that may make the oil non-dielectric. Therefore, despite the filter, the oil of Arutunoff is not inevitably dielectric because the oil could include conductive substances that are not filtered out.

For these reasons, the Examiner's reliance on the oil of Arutunoff being inherently dielectric has no basis, and Applicant respectfully requests that the rejection be withdrawn.

B. REJECTION OF CLAIMS 10-12, 16, and 24-30 UNDER §103(a)

The Examiner argues that Arutunoff discloses all the features of the claims except for a housing having a fluid inlet and a fluid outlet, a fluid pump that circulates a dielectric fluid through the fluid inlet into the cavity and out of the fluid outlet, and a fluid reservoir that houses excess dielectric fluid. The Examiner contends that McCabria discloses a housing having a fluid inlet and a fluid outlet, a fluid pump, and a fluid reservoir, and that it would have been obvious to modify the housing configuration of Arutunoff to accommodate the combination structure as taught by McCabria "in order to improve the cooling system." Respectfully, the rejection fails to establish a proper motivation.

The Examiner is guessing or speculating that modifying Arutunoff with the structure of McCabria would result in an "improved cooling system" without providing any evidence or explanation of what the improvement is or how one would achieve it. For this reason alone, the rejection fails to establish proper motivation and should be withdrawn.

Additionally, the alleged motivation merely recognizes a need to improve cooling and does not provide any suggestion for the particular claimed arrangement. Recognition of a need is not a motivation for a particular solution (See *Cardiac Pacemakers, Inc. v. St. Jude Medical, Inc.*, 381 F.3d 1371, 72 U.S.P.Q.2d 1333 (Fed. Cir. 2004). Thus, the burden remains with the Examiner to provide proper motivation. For this additional reason, the rejection should be withdrawn.

Further, there is no motivation to make the proposed combination. In Arutunoff, the oil circulates only within the machine housing to provide complete temperature equalization within the machine and eliminates deleterious heating of the machine parts. See page 2, lines 102-105. In McCabria, the heat exchanger (86) cools the lubricating oil before the oil enters the generator (10) through the inlet ports (C and D). Thus, the oil entering the generator is cooler than the oil exiting the generator and there is no temperature equalization. Therefore, the proposed combination would ruin the intended operation of Arutunoff to provide temperature equalization by allowing some parts near the inlets to be cooler than parts near the outlets. Therefore, one would not be motivated to make the proposed combination.

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CLOSING

For the reasons set forth above, the rejection of all claims is improper and should be reversed. Such action is solicited.

Respectfully submitted,

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Dated: April 16, 2007

CERTIFICATE OF TRANSMISSION UNDER 37 CFR 1.8

I hereby certify that this correspondence is being facsimile transmitted to the United States patent and Trademark Office, fax number (571) 273-8300, on April 16, 2007.

Matthew L. Koziarz

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CLAIMS APPENDIX

1. An electric motor assembly, comprising:

a fluid circulation circuit;

a housing having a cavity that is fluidly connected to said fluid circulation circuit;

an electric motor having at least one electric motor component disposed in the cavity; and

a thermally conductive dielectric fluid for circulation through the cavity to substantially submerge said at least one electric motor component.

4. The assembly of claim 1, wherein the housing further comprises a cylindrical partition and the electric motor comprises a rotor, a stator iron, and a stator winding, the partition separating the rotor from the stator iron and the stator winding,

wherein a space between an exterior portion of the partition and the housing forms a cavity, and wherein the thermally conductive dielectric fluid fills the cavity to substantially submerge at least one of the stator iron and the stator winding without contacting the rotor.

6. The assembly of claim 1, wherein the dielectric fluid is a dielectric oil.

10. The assembly of claim 1, wherein the housing has a fluid inlet and a fluid outlet, and wherein the system further comprises:

a fluid pump that circulates the dielectric fluid through the fluid inlet into the cavity and out of the fluid outlet; and

a fluid reservoir that houses excess dielectric fluid.

11. The assembly of claim 1, further comprising a heat exchanger in fluid communication with the dielectric fluid.

13. The assembly of claim 1, wherein said at least one electric motor component includes one of a rotor and a rotor bearing substantially submerged in said thermally conductive fluid.

14. The assembly as recited in claim 1, wherein said dielectric fluid is in fluid communication with a bearing which supports a rotor shaft.

15. The assembly of claim 1, wherein said at least one electric motor component comprises a rotor rotatable about a rotor axis, said rotor rotatable while substantially submerged in said dielectric fluid to circulate said dielectric fluid through said cavity.

16. The assembly of claim 1, wherein said fluid circulation circuit includes a portion that is outside of said housing.

17. The assembly of claim 1, wherein said electric motor includes a rotor output shaft that is coupled to a gas turbine engine, said engine in fluid communication with said fluid circulation circuit.

18. The assembly of claim 17, wherein said dielectric fluid comprises engine oil received from said engine through said fluid circulation circuit.

20. A method of cooling and lubricating an electric motor assembly, comprising:

(1) circulating a dielectric fluid through a motor housing cavity having an electric motor disposed therein;

(2) communicating heat from the electric motor directly into the dielectric fluid; and

(3) lubricating a moving component of the electric motor with the dielectric fluid.

21. The method of claim 20, wherein said step (1) further comprises directly transferring heat from a rotor bearing of the electric motor to the dielectric fluid, and said step (2) further comprises lubricating the rotor bearing with the dielectric fluid.

22. The method of claim 20, further comprising:

(4) rotating a component of the electric motor to circulate the dielectric fluid through the motor housing cavity.

23. The method of claim 20, wherein said step (1) further comprises

circulating the dielectric fluid between the motor housing cavity and an engine and selectively operating the electric motor to drive the engine.

24. The assembly of claim 10, wherein said fluid inlet is an exclusive fluid input into said housing.

25. The assembly of claim 10, wherein said fluid outlet is an exclusive fluid outlet from said housing.

26. The assembly of claim 10, wherein said fluid outlet is an exclusive fluid outlet from said housing and said fluid inlet is an exclusive fluid input into said housing.

27. The assembly of claim 12, wherein said fluid pump is located between said fluid reservoir and said filter.

28. The assembly of claim 4, wherein said partition is a cylinder.

29. The assembly of claim 28, further comprising at least one seal member located radially inward of said partition and radially outward of said housing.

30. The assembly of claim 28, further comprising a first seal member located near a first end of said partition and a second seal member near a second, opposite end of said partition.

EVIDENCE APPENDIX

None.

RELATED PROCEEDINGS APPENDIX

None.